1,023,886

PATENT SPECIFICATION

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COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Method of and Mould for Forming a Bushing in an Opening in a Sheet Material Wall, and Sheet Material Wall Produced by Said Method

We, METAL CONTAINERS LIMITED, a British Company, of Seymour House, 17 Waterloo Place, Pall Mall, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

The present invention relates to a method of forming a bushing in an opening in a sheet material wall around the circumferential edge of said wall defining said opening, wherein said bushing is formed by injecting a molten material which solidifies on cooling, into a mould cavity defined by a plurality of separable dies two of which together clamp a portion of said wall around the opening therein while leaving free said circumferential edge.

Conventional methods of this type present certain inconveniences and disadvantages and it is an object of the present invention to provide an improved method of the type set forth by which said inconveniences and disadvantages are overcome.

With this object in view the invention provides a method of forming a bushing in an opening in a sheet material wall around the circumferential edge of said wall surrounding said opening, wherein said bushing is formed by injecting a molten material which solidifies on cooling into a mould cavity defined by a plurality of separable dies two of which together clasp a portion of said wall around the opening therein while leaving free said circumferential edge, said material being injected in a substantially axial direction in relation to said mould cavity.

By means of the invention warious advantages are obtained and disadvantages of conventional methods avoided. Firstly, the method according to the invention is easily applicable to sheet materials of varying wall thickness whereas increase of wall thickness of the sheet material leads to difficulties in known methods. For instance, if the molten bushing material is injected in a radial direction through a web gating increase of the wall thickness of the sheet material leads to increase in wall thickness of the radially extending web resulting in undesirable variations in injection conditions and difficulties in removing the web from the finished article. In another known method a spider gating is used; apart from the risk of the molten material solidifying in the gating and thereby clogging it during removal of the finished article, increase in wall thickness of the sheet material results in a web interconnecting the spider exits being formed.

Furthermore, an advantage of the method according to the invention consists in that it permits molten materials having a higher viscosity to be used and to be injected at higher velocities, as the tendency to bend the unsupported edge surrounding the opening in the sheet material wall is greatly reduced. This is particularly important when a bushing is to be formed in rather flexible sheet material, for instance paper board, fibre or the like.

In a preferred embodiment of the invention the molten material is injected through a continuous annular passage extending substantially axially in relation to said mould cavity. In that case said annular passage preferably opens into said mould cavity substantially at or adjacent to the inner surface wall of said cavity.

The invention also provides a mould for forming a bushing in an opening in a sheet material wall around the circumferential edge of said wall defining said opening by means of injection moulding, said mould

comprising a plurality of dies which are movable in relation to one another and which in their operative position define a mould cavity the shape and dimensions of which correspond to the shape and dimensions of the bushing to be formed, two of said dies being adapted together to clasp a portion of said wall around the opening therein while leaving free said circumferential edge, one of said dies forming a central projection and another of said dies having a central recess formed therein, said projection and said recess together defining a shallow, disc shaped chamber axially spaced from said mould cavity and an annular substantially axial passage from said disc shaped chamber to said mould cavity, and means being provided to connect said disc shaped chamber to a source of molten material.

The method and the mould according to the invention can, for instance, be used for the forming of a bung-hole bushing in a shipping container wall or lid. The material of the container wall or lid may be metal but it may also be non-metal such as a synthetic material, paperboard, fibre, wood, plywood or the like. The wall may also be a composite wall, for instance a metal or non-metal wall having an internal lining and/or an external coating of a synthetic material.

The invention is also embodied in a sheet material wall having a bushing produced by the method and/or the mould hereinbefore described, and in a shipping container having such a wall.

The method and the mould according to the invention will now be described more in detail, reference being made to the accompanying drawings which, by way of example only, show a preferred embodiment of the invention. In these drawings:—

Figure 1 is a vertical cross-sectional view of a mould according to the invention which can be used for carrying the method according to the invention into effect;

Figure 2 shows also, in vertical cross-sectional view, a part of the mould of Figure 1 on an enlarged scale; the left hand portion of this figure shows the position of the dies in relation to one another when the mould is used for forming a bushing in an opening in sheet material having a comparatively small wall thickness, and the right hand portion of Figure 2 shows the position of the dies in relation to one another when the mould is used for forming a bushing in an opening in sheet material having a comparatively large wall thickness.

Referring to these drawings the mould comprises a lower die or base plate 11, an annular upper die 12 and a central die or core member 13. The dies are movable in relation to one another and notably, the central die 13 can be rotated and also withdrawn axially upwards with respect to both other dies 11 and 12. The upper die 12 can be moved axially in relation to the lower die 11, and, for reasons which will appear hereinafter, it is a split ring and it can be subdivided radially, at least into two halves. The central die is formed with external screw threads 14.

In their operative position shown in Figure 1 the dies 11, 12 and 13 together define a mould cavity 15 of which the shape and dimensions correspond to the shape and dimensions of the bushing to be formed.

The lower die 11 and the upper die 12 are adapted together to clamp a portion of a wall 16 of sheet material around an opening therein while leaving free the circumferential edge defining the opening in which the bushing is to be formed.

The central die forms, or is provided with, a central projection 17, whilst the lower die 11 is formed with a central recess 18. The projection 17 together with the recess 18 define a shallow, disc shaped chamber 19 which is axially spaced from the mould cavity 15, and a continuous annular substantially axial passage 20 from the disc shaped chamber 19 to the mould cavity 15.

Means are provided to connect the disc shaped chamber 19 to a source (not shown) of molten material which may be pressurised. In the embodiment shown in the drawings these means consist of an inlet port 21 formed in the lower die 11. The upper die 12 is formed with an annular recess 22 having a shape and dimensions corresponding to the shape and dimensions of a bead which it is desired to form at the upper edge of the bushing.

The operation of the mould shown in the drawings and hereinbefore described is as follows:—

The upper die 12 and the central die 13 having been raised axially clear off the lower die 11 the wall of sheet material formed with an opening is placed on top of the lower die 11 and so arranged that the opening in the wall is co-axially disposed in relation to the mould and its mould cavity 15. Thereupon, the upper die 12 and the central die 13 are lowered into the position shown in Figure 1, so that a portion of the wall of sheet material surrounding the opening is clamped between the dies 11 and 12, the extreme edge defining said opening, however, being left free. Molten material which solidifies on cooling is now injected through the inlet port 21 into the disc shaped chamber 19 and from there through the continuous, annular, axial passage 20 into the mould cavity 15 and thus in an

axial direction in relation to the mould cavity. As shown in the drawings the annular passage 20 opens into the mould cavity 15 at or adjacent to the inner surface wall of the mould cavity. Thereby, the risk of inflowing molten material directly hitting the edge of the wall 16 and bending or otherwise deforming this edge is avoided. Consequently, molten materials having a higher viscosity may be used and may be injected at higher velocities even if the sheet material is rather flexible, for instance when it consists of paper board, fibre or the like.

When the mould cavity 15, and thus also the passage 20, the disc shaped chamber 19 and the inlet port 21 have completely been filled up with molten material the latter is allowed to cool down; thereto, the mould may be cooled artificially. The material in the mould cavity, the annular passage, the chamber and the inlet port thereby solidifies, resulting in a bushing provided with internal screw threads and a beaded upper edge being formed in the opening in the sheet material wall and about the circumferential edge of the wall defining the opening therein.

The mould is now opened by unscrewing the central die 13 out of the screw threads in the bushing, splitting the annular upper die 12 thereby releasing the bead at the upper edge of the bushing and by moving both dies upwardly away from the lower die 11. The wall 16 can now be removed from the mould. Finally, the dead head formed by the material which has solidified in the annular passage 20, the disc-shaped chamber 19 and the inlet port 21 can be separated from the finished work piece by trimming it off at or adjacent the point where the annular passage 20 opens into the mould cavity 15.

As shown in Figure 2 there is no essential difference in the conditions whether a bushing is to be formed in a wall of sheet material having a small wall thickness (left hand portion of Figure 2) or in one having a considerably greater wall thickness (right hand portion of Figure 2). Actually, the only difference consists in an increase in depth of the chamber 19 on increase in wall thickness of the sheet material 16. Thereby, the weight of the lost head will also increase but no increase in loss will thus be caused, since the lost heads are melted again to form further bushings or other articles.

The wall 16 may be a wall or a lid of or for a shipping container and the bushing formed in an opening therein may be a bung hole bushing. The wall material may be metal but it may also be non-metal such as a synthetic material, paperboard, fibre, wood, plywood or the like. The wall may also be a composite or laminated wall, for instance a metal or non-metal wall having an internal lining and/or an external coating of a synthetic material.

WHAT WE CLAIM IS :—

1. A method of forming a bushing in an opening in a sheet material wall around the circumferential edge of said wall defining said opening, wherein said bushing is formed by injecting a molten material which solidifies on cooling, into a mould cavity defined by a plurality of separable dies two of which together clamp a portion of said wall around the opening therein while leaving free said circumferential edge, said material being injected in a substantially axial direction in relation to said mould cavity.

2. A method as claimed in claim 1, wherein said material is injected through a continuous annular passage extending substantially axially in relation to said mould cavity.

3. A method as claimed in claim 2, wherein said annular passage opens into said mould cavity substantially at or adjacent to the inner surface wall of said cavity.

4. A mould for forming a bushing in an opening in a sheet material wall around the circumferential edge defining said opening by means of injection moulding, said mould comprising a plurality of dies which are movable in relation to one another and which in their operative position define a mould cavity the shape and dimensions of which correspond to the shape and dimensions of the bushing to be formed, two of said dies being adapted together to clamp a portion of said wall around the opening therein while leaving free said circumferential edge, one of said dies forming a central projection and another of said dies having a central recess formed therein, said projection and said recess together defining a shallow, disc shaped chamber axially spaced from said mould cavity and a continuous annular substantially axial passage from said disc shaped chamber to said mould cavity, and means being provided to connect said disc shaped chamber to a source of molten material.

5. A sheet material wall including a bushing formed in an opening therein by the method as claimed in any of claims 1 to 3.

6. A shipping container including a wall made of sheet material as claimed in claim 5.

7. A method of forming a bushing in an opening in a sheet material wall substantially as herein described with reference to the accompanying drawings.

8. A mould for forming a bushing in an opening in a sheet material wall substan-

tially as herein described with reference to the accompanying drawings.

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1,023,886 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

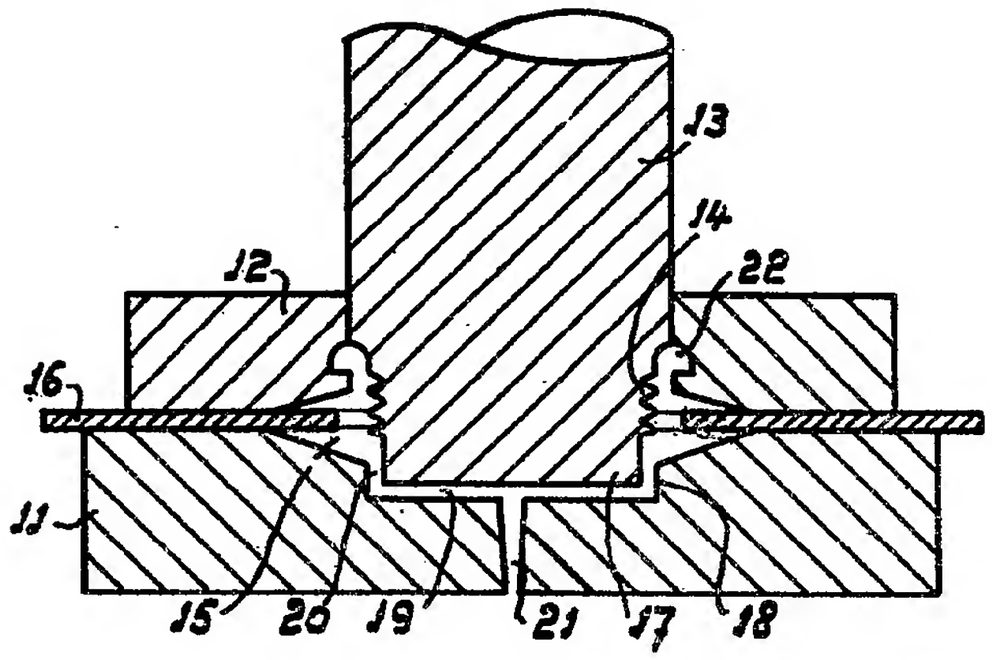

FIG. 1

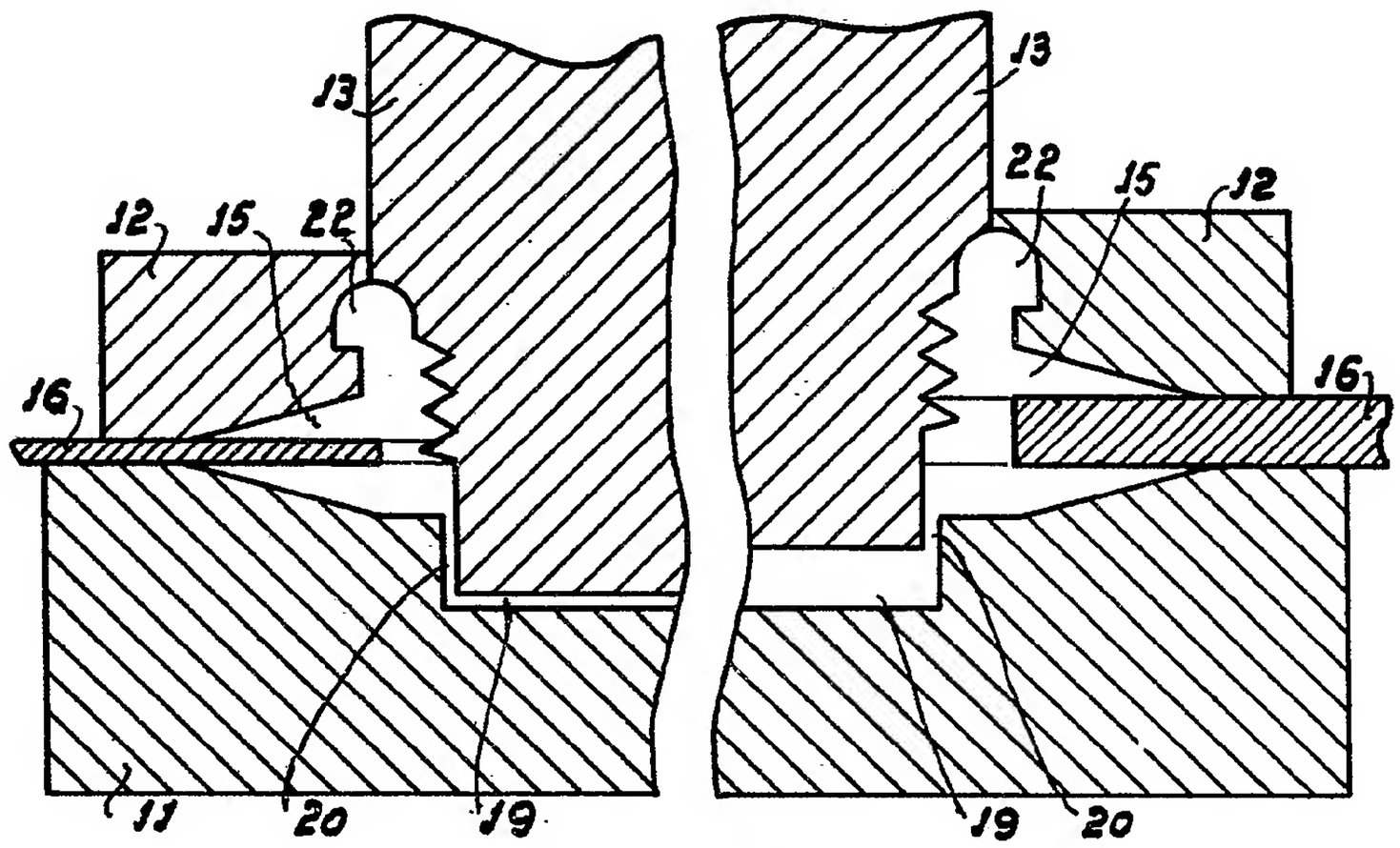

FIG. 2